DOCUMENT RESUME

ED 262 995 SE 046 209

AUTHOR Raat, Jan H.; And Others
TITLE Girls And Science And Technology (GASAT). Proceedings of the Conference (1st, Eindhoven, The Netherlands, November 9-13, 1981). Volume 1.
INSTITUTION Eindhoven Univ. of Technology (Netherlands).
REPORT NO ISBN-9066-56-502-0
PUB DATE Dec 81
NOTE 37p.; For related documents, see SE 046 210 (Volume 2) and SE 046 211 (Volume 3).
PUB TYPE Collected Works - Conference Proceedings (021)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Curriculum Development; Elementary School Science; Elementary Secondary Education; *Females; Higher Education; Instructional Materials; *Science Curriculum; Science Education; *Science Instruction; *Secondary School Science; Sex Bias; Sex Differences; Sex Stereotypes; Teacher Education; *Teaching Methods; *Technology

ABSTRACT

An international conference was held: (1) to determine what can be done to make science (particularly physics) and technology more attractive to girls; (2) to examine how girls who study science and technology can have the same opportunities as boys have; and (3) to see that girls have the same results in science and technology as boys have. These proceedings, presented in outline format, give a report of that conference. They include a preface, comments on preparing for the conference, the conference, recommendations, and follow up activities. The conference includes: the opening address; the program; teacher education activities; activities related to support for women, including classroom intervention at various age levels; and issues related to curriculum and instructional materials (considering content of instruction, teaching methods, classroom management, and textbooks). Two of the recommendations offered are to keep statistics that separate data of girls and boys to make different educational outcomes visible and to orient pre- and in-service teacher education toward making teachers aware of society's attitudes toward young women and to make teachers aware of their own attitudes. (Lists of participants, discussion/research papers, and discussion questions are provided in appendices.) (JN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED262995

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

√ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

SE046209

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Jan H. Raat

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

C copyright 1981 Jan H.Raat, Eindhoven University of Technology
All rights reserved. No part of this book including tables may be reproduced without permission in writing from the editor.

uitgevers- en handelmaatschappij VeWe b.v. - mijdrecht
TELEX 18746 - TELEFOON 02979-1251 (Interlijn 52)
ISBN 9066 56 502 0

Jan H.Raat
Jan Harding
Ilja Mottier

PROCEEDINGS GASAT - CONFERENCE 1981

Report of the conference Girls And Science And Technology

GASAT - 1981
volume 1

Eindhoven University of Technology
Eindhoven, The Netherlands, 1981

GASAT RESOURCES INFORMATION CENTRE
Department of Physics & Technology
Eindhoven University of Technology
Postbox 513
5600 MB Eindhoven, The Netherlands

PREFACE

The first international GASAT-conference
(GASAT = Girls And Science And Technology)
was held at the Eindhoven University of Technology (THE)
in Eindhoven, The Netherlands, November 9 - 13, 1981.

These *PROCEEDINGS* give a report of that conference.

The text of the papers, discussed during the conference
and used as material for those discussions, is published in
Contributions GASAT-conference 1981.

In the congressbook *GIRLS AND SCIENCE AND TECHNOLOGY. GASAT-conference 1981* more information is given about the conference, its background and the prospects.

Jan H. Raat
Jan Harding
Ilja Mottier

Eindhoven University of Technology
December 1981.

Mailing address:
Jan H. Raat,
THE, Postbox 513,
5600 MB Eindhoven,
The Netherlands

BEST COPY AVAILABLE

CONTENTS

Preface, 1

1. Preparation of the GASAT-conference

1.1 Deliberations leading to the GASAT-conference, 2
1.2 Organization of the conference, 2
1.3 Invitations to the conference, 3
1.4 Background to the GASAT-problem, 3
1.5 The consequences, 3
1.6 The purpose of the conference, 3
1.7 The participants, 4
1.8 Conference papers, 5

2. The GASAT-conference

2.1 Opening address, 6

2.2 The programme, 6

2.3 Group 1. Teacher education, 7
2.3.1 Starting points, 7
2.3.2 Possible challenge activities, 7
2.3.3 Research suggestions, 8

2.4 Group 2. Support for women, 9
2.4.1 0-12 years Outside classroom intervention, 9
2.4.2 6- 9 years Classroom intervention, 10
2.4.3 9-12 years Classroom intervention, 10
2.4.4 12-15 years School intervention, 11
2.4.5 University/College Level, 13
2.4.6 Ultimate Summary, 14
2.4.7 Materials on: Sex Equity in Science and Engineering, 14

2.5 Group 3. Curriculum and teaching material, 15
2.5.1 Content of Instruction, 15
2.5.2 Teaching Methods, 16
2.5.3 Classroom management, 17
2.5.4 Textbooks, 18

2.6 Discussion of group reports, 18

3. Recommendations, 20

1. Statistics, 20
2. Information network, 20
3. Teacher education, 20
4. Curriculum and teaching material, 21
5. Support, 21
6. Research, 22

4. Follow up of the conference, 23

4.1 Congressbook, 23
4.2 Information network, 24
4.3 Next GASAT conference, 24

Appendix A. List of participants, 25
B. List of papers, 26
C. Some questions for discussion, 28

1. PREPARATIONS OF THE GASAT-CONFERENCE

1.1 Deliberations leading to the GASAT-conference

On recent years in The Netherlands as in other Western countries people learned to pay attention to the question of the disadvantage of girls and women in the education of science (especially physics) and technology. Here, in The Netherlands, there was a workshop "Girls and Physics" (Woudschoten conference, 1979) and the publishing, as a direct consequence, of the report "Marie, word wijzer..... van natuurkunde" (i.e. "Girls and physics education")(Mottier, Raat, 1980.)

Prof.dr. Jan H. Raat and drs. Ilja Mottier visited dr. Jan Harding, who chairs the Girls and Physical Science (GaPS) sub-committee of the Association for Science Education (ASE), at Chelsea College, University of London. She reported visits from several people from different countries, who were interested in the same problem. The idea arose to have a rather small international working conference for those working in the field of reducing women's disadvantage in science and technology.

In The Netherlands there were the HANDROVER-project, dealing with sex roles in textbooks; started in 1979 (Mottier) and the MENT-project, dealing with girls, physics and technology ;started in 1981 (Raat).

A grant from the Dutch Ministry of Education helped to realize the idea-- and the GASAT conference

was held in Eindhoven, November 9 - 11, 1981.

1.2 Organization of the conference

The conference was organized by the Department of Education of teachers of physics and technology of the Eindhoven University of Technology (THE), in co-operation with the HANDROVER-project on sex sterotyping in textbooks, and with Chelsea College London.

The preparatory committee: Mathieu Dumont, ir. George Itz, prof.dr.Jan H.Raat, Marja Rooijakkers (secr.), drs. Gerrit Verkerk - (THE); the programme and paper-committee: prof.dr. Jan H. Raat (THE), drs. Ilja Mottier (HANDROVER-project), dr. Jan Harding (Chelsea College London).

1.3 Invitations to the conference

After the decision to organize the GASAT-conference in 1981 was taken, an invitation was sent to possible participants. The maximum number had been fixed at 30 (20 from abroad, 10 from The Netherlands).
Here we quote from this invitation:

"1.4 Background to the GASAT problem

Girls and women still have a disadvantage in science (especially physics) and technology, as has been shown by many statistics of the last decades. Investigations show that probably most of the causes have to be found in sociological circumstances. Society as a whole, education at home as well as in the schools, offer more and better opportunities to boys to learn science (especially physics) and technology.
Many researchers assume that the way in which physics and technology are presented in schools also gives girls less opportunities.
So one could say that girls and women have at least a double handicap, when learning science (physics) and technology:
1° they may enter the lessons in these subjects with a less positive attitude and
2° the content of physics and technology, as offered at schools, and the way of presentation attract boys more than girls.

1.5 The consequences

By this girls have smaller chances, when entering a vocational training or when choosing a job. Many attractive professions and jobs are much less accessible for girls than they are for boys.
Secondly, by disadvantaging girls in the field of education of science (physics) and technology, one is wasting talent.
But the most serious grief is perhaps: girls, being systematically disadvantaged in the education of science and technology, enter the adult life and society with less formation in such an important part of the cultural as well as the professional world as science and technology are.

1.6 The purposes of the conference

a. We now believe to be at the point that, while in many countries one has some experience in tackling the problem and at the same moment in other countries people are starting to see what one could do to make science and technology more attractive to girls, it is rather important to collect the experiences existing at this moment.

Maybe it is even more important to bring together those who really are involved in research now, in designing and/or starting programs to get more girls to the study of science (physics) and technology.
The problem, for this first conference, is - as we see it now- concentrated on the science and technology students of secondary schools (students of age 12-15 (18)years). At that age most choices have to be made.
So, as for us as organizers of the seminar, we like to declare that the main problem the conference will be dealing with is:
what can we do to make science, especially physics and technology more attractive to girls; how can we achieve that girls, when studying science and technology, have the same opportunities as boys have; that girls have the same results in science and technology as boys have.
The problem is concentrated on, but not restricted to the secondary school students.
b. We hope and expect, that this conference will be followed by more on the same topic, the problem of the disadvantage of girls in science and technology being at the same time too complex to be solved in one seminar and serious enough to go on to overcome it.
As a automatic purpose of this conference we see the preparation of the second one.

1.7 The participants

Those women and men are invited who are actually involved in programmes, investigations, policy regulations.
The main part of the participants are the women and men, who bring some experience of the conference-subject, and are looking for taking home what they learn from others at this point during the congress.
Since in The Netherlands of all scientific subjects girls are most disadvantaged in physics, we put the accent on physics (and technology) . But participants from other countries may have other experiences and may wish to stress other aspects of science".

Thirty participants attended the conference, the names and addresses are found in Appendix A. [The Belgian participant and one from the USA cabled on the first day of the conference that they were prevented by personal reasons from attending.] Although approaches were made to Denmark, Italy and France no participant from these countries could be contacted in the time available. Invitations were also sent to Unesco, Council of Europe and the European Committee. The representatives showed themselves highly interested in the topic, but heavy workload and other commitments made their participation impossible.

1.8 Conference paper(s)

In answer to the invitations a number of papers were received. Twenty-one contributions were accepted. Some more were produced during the conference. The list of the papers is given in Appendix B. The full text of the papers can be found in: *CONTRIBUTIONS GASAT-conference 1991*.

The CONGRESSBOOK, *GIRLS AND SCIENCE AND TECHNOLOGY, GASAT-conference 1991* to be published spring 1992, will include the contents of the papers, summarized by nation.

2. THE GASAT-CONFERENCE.

2.1 Opening address

Ms. ir. B. ten Zeldam, deputy secretary-general of the Dutch Ministry of Education held the opening-address, Monday, November 9th.

An address of welcome was given by mr. drs. H.J. ter Heege, president of the Board of THE.

2.2 The programme

Tuesday, Wednesday, Thursday, November 10, 11, 12 were used for discussions, in groups as well as in plenary sessions. The final session on Friday, November 13 was devoted to the discussion of the group reports and to the expression of the RECOMMENDATIONS.

Before the conference the participants received a copy of the papers (nrs. 1-21). As they were asked to have studied them before arriving at Eindhoven no lectures were given; the discussions started right from the beginning.

A series of questions had been extracted from the papers by dr. Jan Harding. These were given to each participant on arrival (Appendix C).

During the conference time was set aside to show videotapes:

- Jan H. Raat presented a video-tape of the *pendulum-experiment* showing the different role-behaviour of 13-year-old girls and boys, when doing a simple experiment in physics (girl-boy interaction; boy-boy interaction; girl-girl interaction and boy-girl-girl-boy interaction). The tape can be used to demonstrate this difference to teachers in pre-service as well as in in-service training.

The experiment has been described by Mathieu Dumont (paper nr. 20).

- Deanna Chitayat presented some video-tapes prepared for the *ISTOMIC-project* (paper nr. 3).These showed stimulus used in small leaderless groups of teachers to enable them to examine their assumptions about sex stereotyping and situations showing men and women in a-typical jobs, to be used in classroom discussion with pupils.

The conference work started Tuesday morning with a plenary session. Although all countries present have problems in attracting girls into science and technology, those problems may differ in detail because of the differences in the various schoolsystems. Therefore the first hours were devoted to a brief explanation of the schoolsystems of the countries represented and to the place of physics and technology in these systems.

After a short plenary discussion the participants split up in four groups. The groups came together without a special programme, but with the intention to discuss freely all possible problems, to compare opinions, to see where consensus existed, and then to report back which specific points they thought the conference should devote attention to.

The result of the first discussions was that three main topics were identified: *teacher education*, *support of women* , and *curriculum and teaching material*. These three groups spent many hours working together. They wrote down their conclusions.

These were distributed and commented upon in plenary session by all the participants.

2.3 Group 1. Teacher education

The group was formed by:
Deanna Chitayat, Cathalijn Drukker, Jan Harding, Jan Hoogeveen, George Itz, Lena-Pia Lindholm, Don Low, Isabel Romão, Marja Rooyakkers, Svein Sjøberg and Gerrit Verkc.s.
The teacher education group wants to influence teachers' assumptions about and attitudes towards girls in science and technology and to do it in such a way that no extra resistance is created.

Therefore a number of activities is suggested: questions, discussions, development of materials. Finally research topics are formulated.

2.3.1 Starting points

1. To challenge teachers' assumptions about girls in science and technology.
2. To prevent extra resistance. Since science teachers may be suspicious about behaviour changing techniques, it is necessary to enter gently.

2.3.2 Possible challenge activities

Put questions like:
- why teach science?
- how many women work in various activities?
- what qualities do males and females possess?
- what qualities are needed to study science?

The level of awareness varies, possibly from cognitive (less threatening) to affective (more personally involved).
We can order a sequence of questions accordingly:
(i) How many women/girls are studying/working in the field of science and technology?

(ii) Why do we want more girls in science and technology?

(iii) How do we affect the situation?

With questions like these in mind, the following sequence could be used, for example in workshops:

(i) A quiz:

Guess statistics about real situations of women and men in occupations, girls in subjects at school, in textbooks, etc.

Then confront with the correct answers (possibly statistics of different countries); discuss (with a prize for the best answers!).

(ii) Respond individually to a list of 'why teach science' reasons.

Discuss in group, defending and attacking positions until consensus is reached.

(iii) Respond to a list of qualities needed to study science.

(iv) Respond to male/female qualities.

These lists should be generated by discussions with groups of teachers (probably physics, chemistry, biology and technology teachers separately).

Each activity should include stimulus material for discussion, such as:

- video (if finance available);
- slides and audiotape;
- pictures, posters;
- printed materials.

But care should be taken that they carry conviction , and don't seem alien to the groups which use them.

These materials should be available internationally through a RESOURCE BANK .

2.3.3 Research suggestions

1. Longitudinal case studies of intervention.

These may be difficult to carry out methodologically but may be valuable to feed as evidence to teachers and also may show difficulties in bringing about change.

2. Evaluation of strategies.

(i) Formative evaluation: continual monitoring, perhaps selfmonitoring, of changes in expectations

(ii) Scale to evaluate sex role attitudes, which could be used in pre-course and post-course situations

3. Teacher/boy/girl interactions.
   (i) Frequency of interaction
   (ii) Quality of interaction - type of questions, praise, behaviour, etc.

4. Possible male/female bias of appeal in topic presention, images, analogies and words.

5. Test construction:
   - science anxiety
   - attitudes to science
   - attitudes to technology.

   Existing attitude scales were largely generated with boys. They may be inappropriate to use with mixed groups, or with girls.

6. High/low performance situations.
   Identification and study of mixed schools with different outcomes e.g. of girls choosing to work in science and technology.

2.4 Group 2. Support for women.

The group was formed by:
Mary Anderson, Ruth Anne Cade, Geoff Chivers, Mathieu Dumont, Janet Ferguson, Lucile Fink, Ineke de Raaff, Barbara Simpson, Barbara Smail.

The group has considered the needs of young women and women at different ages and has formulated a great number of support activities. The suggestions are given here without much comment.
The topics speak for themselves.

2.4.1 0-12 years. Outside classroom intervention.

A. Non-sexist toys and games
   i. Market argument to be used with manufacturers
   ii. Awareness through Parent-Teacher Associations
B. Non-sexist books (positive images)
   Guidelines for publishers
   i. Textbooks
   ii. (Children's) literature
   iii. Magazine, comics (also women's magazines)

C. Media

i. Educational television

a. Guidelines for tv-script writers to include women (and ethnic minorities)

b. Positive image of women scientists

c. Application of science to everyday life

d. Presence of women at all levels in non-traditional occupations.

e. Social significance of science and technology to personal life

f. Career information: pamphlets with pictures of girls

ii. Non-educational television

a - e Same as above

f. Featuring more heroines in commercial non-documentary programs (non-traditional "women heroes")

2.4.2 6-9 years Classroom intervention

Research:

1. What concepts do girls lack at this age relating to science? (which make them feel uncomfortable with math and science)
2. Role of sports in developing skills, concepts and attitudes which foster involvement in science
3. Boy/girl interrelations, differences and consequences
4. Intrinsic versus extrinsic motivation of girls related to science/non-traditional roles.

2.4.3 9-12 years Classroom intervention

A. Role Model: Woman Scientist

i. Practical Problem-Solving Activities

ii. Separate boys/girls for activity(ies) (same class, same time, same woman scientist

B. Role Model: Young Woman studying Science (12-18 years)

i. Demonstrate Science Fair Project

ii. Report on Science Club, class projects

C. Work with Girl Scouts or Girls Clubs

i. Career Badges (Computers, Science, Engineer, etc.)

D. Science Field Trip
   i. Visit high school lab
   ii. Some girls demonstrating in lab
   iii. In conjunction with regular Parent Evenings in high school
   iv. Planned activity to be done by segrated boy/girl groups
E. Use of Computer to Stimulate Interest
   i. Field Trip
   ii. In-class Demonstration by Woman with Interactive Project
F. Encourage domestic projects for boys, manual projects for girls

2.4.4 12-15 years School Intervention

A. Science Club for Girls
   i. Assertiveness training
   ii. Attachment with Women Scientists
   iii. Hands-on projects
   iv. Visit primary schools
   v. Encourage positive self-image as women competent with science and technology
   vi. Positive self-image (general)
B. Establish network of high school faculty who are actively supportive of women in science
   i. Science teachers taking summer courses such as computer course can be used as contact
   ii. Through administration (policy incentives)
C. Summer Science Camps
   i. 3 days-several weeks: beginning computer course, for example
D. Women in Science Visiting Program
   i. Relate work
   ii. Use college woman in science
   iii. Career Information
      a. motivation
      b. life style (marriage/family; job satisfaction)
      c. opportunities
      d. preparation -classes
         -personal contacts
         -understanding the system

E. Career Day
   i. Industrial Involvement
   ii. Exhibitions (pictures of women)
   iii. Career Information (see above)
   iv. Role Models

F. Use of women's scientific organizations
   i. Society of Women Engineers
   ii. etc.

G. Industry
   i. Field trip
   ii. Representative to speak in school
      a. assigned to a particular school
         (included in related activities)

H."Insight into Engineering"
   i. Week on university campus
      a. learn about areas of engineering
      b. project
      c. career information
      d. campus familiarization, etc.

I. University/College Network
   i. Admissions, financial aid for students as well as for faculty to facilitate entrance of high school girls to college

J. Big Sister Program
   i. Through science club?

K. Day contest
   industry and school competition by size of school
   i. exams
   ii. practical projects

L. High School Counsellor Education
   - workshop; some specific direction for women

M. Network of supporting scientists - men and women

Messages on

Assertive/Self Awareness:

1. Right to ask
2. Don't have to like math and physics
3. OK to excel
4. Not necessary to excel
5. Girls often don't decide on career until 18 or later
6. Keep options study or career open by taking math and physics
7. Science is for everyone (even if not major area)
   a. responsible citizen (decisions on power)
   b. enhance internal locus of control
   c. needed for intelligent decisions and choices
   d. personal impact and impact on community, country
   e. many jobs use science
8. Science can be fun
9. Working with hands is not bad
10. Hands-on experience not a prerequisite to studying science
11. High possibility of need for job
12. Working can be fun
13. Awareness of job market
14. Encourage consideration of career goals
15. Easier to take science now than later
    a. Science is better studied systematically in school
    b. Other subjects may be studied easier later
16. Test-taking strategies
    a. Guess (unless penalized)
    b. Do easy questions first

2.4.5 University/College Level

A. Retention

i. Pre-introduction Week of (Engineering) students
   develops peer support group

ii. Counselling
   supportive network (can include women's center)

iii. Student Society of Women Engineers

iv. Good academic advisement

B. Recruitment
   i. Women from other disciplines
   ii. Young women with high school knowledge of science

C. Career information
   i. Job hunting skills
      a. Resume writing
      b. How to choose a company
      c. Interviewing
   ii. Job opportunities
   iii. Job content information
   iv. The industrial system
      a. Organization psychology: theory and practice
      b. Learning the System

D. Role models/Mentors

E. Re-entry Information(before they leave)

F. Assertiveness Training

Re-entry Women into Science
Facilitate re-entry for science and non/science backgrounds
Science workshops

2.4.6 Ultimate Summary:
A. Public Awareness
   i. Increase positive publicity for girls in science

2.4.7 Materials on: Sex Equity in Science and Engineering
A. International Resource Center (Clearing House)
   (Suggestion: such as: American Women in Science
   American Association for the Advancement of Science
   NSF (Women in Science, if continues to exist))
   i. Minimum requirement
      list of available material, upon request one copy available or where to get, price list
   ii. Center for Distribution
      a. one in United States and one in Europe
      b. UNESCO
         one clearing house (Paris?)
   iii. Committee to follow-up on establishment

B. Immediate Action:

a. Each participant prepares own bibliography of materials on present topic and other materials of interest for distribution to participants within 6 months.

b. Coordinator of above

2.5 Group 3. Curriculum and teaching material

The group was formed by:
Harrie Hermans, Lore Hoffmann, Jan Hondebrink, Svein Lie, Ilja Mottier, Jan Raat, Doris Simonis.

The group concentrated on proposals for change and discussed new topics that could be introduced in the curriculum.

Methods of teaching were discussed, where great emphasis, in this group, was put on favouring active inquiry in girls, in teaching them to take risks, even without praise from teachers.
The content of existing teaching material was frequently subject of discussion in the other groups too. Some of their remarks will be summarized under heading 4 "Textbooks".

(See also the recommendations of group 2, especially paragraph 1, "Outside classroom intervention".)

2.5.1 Content of Instruction

Topics in physics should be re-evaluated. Emphases on natural environment, energy and familiar technology should be foremost.

a. Choice of topics and their development are important.
Examples of topics likely to be more interesting and appropriate for girls and boys (aged 11-15) than those presently used are:
weather, earthquakes, tides, topics from earth science;
examples from the human body;
examples from everyday life("kitchen physics" and "bicycle physics")
Development of topics should start from the familiar natural phenomena first, concepts second, formulae third.

b. Some historical examples of scientific methods and contributions may be of value to draw attention to science as a creative human activity.
Knowledge of the development of modern science and its consequences may be important for understanding of its social benefits and risks.

c. More balanced presentations should be made of concepts and applications of science, a wider range of examples of useful technology should be given.

d. Controversies in applications of science, or in acceptance of theories which reflect social concerns (as in uses of atomic power and the creation evolution contest in U.S.) should be introduced for discussions to highlight the influence of science and technology on the welfare and the culture of human society and vice versa.

2.5.2 Teaching methods

Teachers should be made aware of

a. Tendencies to recognize and encourage boys more than girls by expecting more active cooperation, directing more questions, and/or calling more often on boys for responses. "Pygmalion effect" in real.

b. The negative aspects of immediate "positive reinforcement" for girls. Encouragement and support for self-initiated inquiry and continuing investigations are essential to sustain interest and performance of girls as independent learners.
Because young women are accustomed to seeking social approval and thus avoid intellectual risk-taking, science teachers must make special efforts to be non-directive "coaches" rather than authoritarian directors in their classroom. As Jerome Kagan expressed it " Boys figure the task; girls figure the teacher". The science teacher may have special responsibility to provide alternatives to these orientations.

c. Role- playing, discussions ofcontroversial issues in applications of science and/or technology where each student must contribute an opinion and support it. Brain-storming in groups where every student in turn contributes to problem-solving are strategies to be included in the teacher's repertoire.

d. Open-ended questions with no "right" answer should sometimes be used.
Questions (to be answered by experiential data) should never contain their own answer (e.g. Why is Material A a better insulator than Material B?).

e. Students should do activities themselves and be permitted to observe and explain phenomena that challenge their assumptions and expectations.

2.5.3 Classroom management

a. Group activities and team projects may require special arrangements if the teacher is aware of young women's less active envolvement. Usually girls respond and perform better if paired with girls.

b. Expectations that all students will contribute to inquiries and discussions, will form opinions and offer hypotheses, should be reinforced by taking turns or sequencing reports arbitrarily, if necessary, to insure that each student has opportunities to respond publicly and individually. If team consensus has been sought, assign a different "reporter" for each question.

c. Do not allow neatness and precision in written work to substitute for initiative, ideas and risk-taking.

d. Avoid liberal use of praise and criticism to manipulate behaviour. Strive to develop an atmosphere of openness to alternate explanations, diverse opinions, and fair comparisons.

e. Analogies should be used selectively and new ones developed that relate to phenomena noted as interesting and familiar to young women.
Youngsters can be taught to develop some analogies themselves, displaying understanding of key concepts.

f. Curriculum should include activities students can do individually or in same sex groups. Results of their activities should not be isolated bits of information but should be used as a "hinge" to the next lesson or topic whenever possible.
Students should do activities, not just see pictures of other youngsters doing them. Reporting and discussing results of experiments orally, each person in turn, may be valuable experience.

g. "Fairness" of experimental set-ups (when used) should be emphasized. Encourage development of formal mental structure by always asking for adequate comparative data or "control".

h. When mathematical expression is important, spend time developing the formulae verbally and through data collected. Point out consistencies, relationships attended to.

2.5.4 Textbooks

1. Existing textbooks (and other teaching materials) must be examined to see whether they contain elements that disadvantage girls. All sexism must be removed.

2. Guidelines must be established for the production of new textbooks. They must deal with the content of instruction and with the language used, the illustrations, the examples, the illustrative texts.

3. Slides or pictures are needed which show men and women working in areas related to each science topic on the curriculum.

4. Research outcomes must be related to the production of textbooks. For example the topic raised by group 2: What concepts do girls lack (at a certain age) relating to science? Or a problem like this: What illustrations do appeal to girls. What makes a textbook attractive?

2.6 DISCUSSION OF GROUP REPORTS

The reports of the three groups reflected the views of the participants of those groups. This doesn't necessarily mean that members of other groups agreed on all points.
This became clear in the discussion that followed the reports of the working groups.

On some points differences of opinion arose.
Much doubt was expressed on the viewpoint of group 3, (stating that girls should not be praised too much, since this would make them dependent on teachers, but that they must be stimulated to think independently to develop their creativity). The necessity of fostering creativity was unanimously recognized, but many participants felt it necessary to encourage especially the girls.
Another point of debate formed the inclusion of history and philosophy of science in the curriculum . Whereas some were in favour of it, others cited experiences of projects where this strategy had not worked.
Whether science fairs, contests, etc. would be a good thing for girls was questioned too. Some said boys were more attracted by competitions than girls. But this may depend of the age of the students. Young girls (9-12 years) are still likely to compete. Maybe competitions with only girls would bring a solution.

The conference agreed upon two important points.

1. Girls do participate less than boys in science and technology instruction and in related performance.
   It is good to formulate an intervention strategy to enhance girls' participation.
   But this strategy must be given shape without maintaining existing stereotypes.
2. Intervention strategies are founded upon the deficiency of girls' enrolment and participation in science and technology instruction, not upon the deficiency of female persons.
   Girls must not be conceptualized as deficient boys and the male standard need not be the unique standard.

Problems that were mentioned, but not discussed fully were:
what do we mean by technology in the school context? Is it learning about applications of science, or being personally involved in problem-solving or using 'technology'?
And should we work with boys and men - if so, how?

3. RECOMMENDATIONS

After the plenary discussion on the group reports, the conference discussed a set of recommendations.
These are the recommendations that were agreed upon:

1. *Statistics* must separate the data of girls and boys in order to make different educational outcomes visible.

2. An *information network* must be built in order to facilitate communication between educators, scientists and researchers involved.
This purpose will be served best by an international clearing house, gathering information on:
   - (research) literature
   - resources
   - career information, etc.

3. *Teacher education* can play an effective role
- in pre-service education
- in in-service education

Both forms of education must be oriented towards the following objectives:
- make teachers aware of society's attitude towards (young) women;
- make teachers aware of their own attitude;
- make teachers aware of classroom interactions (teachers - students and students - students);
- make teachers aware of career opportunities for girls and boys in science;
- inform teachers about alternative strategies in science teaching.

These objectives cannot be fullfilled only by providing information. Other methodologies must be used too in order to bring about attitude change.

4. *Curriculum and teaching material* can contribute to promote girls' opportunities.

- Sex discrimination in teaching material and textbooks must be removed.
- Examples and illustrations in textbooks must be based on girls' experience too.

Science must be presented as an endeavour of women and men with historical, cultural, social and economic implications:

- The content of textbooks must not be too far from daily life. Presentation should not be abstract, formalized and theoretical, but rather concrete, connected with real life processes.
- Science lessons must pay attention to the social implications of science and technology. They must deal with the benefits of technological development, but also with the negative consequences, and/or controversial issues.
- Textbooks can use the biography of women scientists as an illustration of science as a human activity.
- Career materials must be developed for girls.

Teaching materials must include a variety of methods, for example problem solving, decision making, design, hands-on.

5. Informative, social and emotional *support* must be given to girls and young women. Some examples:

Informative support:

- information about consequences of subject choice
- information about (non-traditional) careers

Social support:

- positive image in media
- financial aid
- extra courses

Emotional support:

- role models
- female networks

6. More research is needed in order to know the problems and thereby change the situation.
Evaluation research into the effects of ongoing projects is important to form a body of knowledge as a basis for future experiences.
Longitudinal evaluation is essential in this context.

4. FOLLOW UP OF THE CONFERENCE

4.1 Congressbook

It was decided to make a congressbook (of a restricted number of pages)
GIRLS AND SCIENCE AND TECHNOLOGY. GASAT-conference 1981
with the chapters:

1. Introduction: How it arose; list of participants

2. Opening address: Ms. ir. B. ten Zeldam

3. Setting the scene: Backgrounds & emphases

4. i Initiatives in The Netherlands
   ii " " England and Wales
   iii " " Sweden
   iv " " Norway
   v " " W. Germany
   vi " " Portugal
   vii " " the US
   viii " " Canada

5. Conference deliberations

6. Future directions

7. Bibliography

The book will be edited by Jan H. Raat, Jan Harding, Ilja Mottier and published by the Department of Physics and Technology Teacher Education of THE.
The congressbook is expected to be ready spring 1982
the estimated price being about Nf 20 (i.e. about $ 8).

4.2 Information network

Recommendation nr. 2 is dealing with an information network in order to facilitate communication in the field of the GASAT-problem.
It was proposed that the Department of Physics and Technology Teacher Education of THE should start this network and spread the received information to the GASAT-participants.

4.3 Next GASAT conference

The decision was made to try to organize the next GASAT-conference to be held May/June 1983 in Norway. As second possibility for this conference Loughborough, U.K. was mentioned.

LIST OF PARTIPANTS

dr. Mary R. Anderson, Arizona State University, USA.
dr. Ruth Ann Cade, University of Southern Mississippi,USA.
Deanna Chitayat Ph. D., City University of New York, USA.
dr. G.E. Chivers, University of Technology, Loughborough, UK.
Cathalijn Drukker, College for secondary education, Dalfsen, The Netherlands.
Mathieu Dumont, Eindhoven University of Technology, The Netherlands.
Janet Ferguson, Science Council of Canada, Canada.
prof. Lucile Fink, Montclair State College, New Yersey, USA.
dr. Jan Harding, Chelsea College, London, UK.
Marijke van Hemeldonck, Ministry of Education, Brussel, Belgium. (excused)
drs. Harrie J.C. Hermans, Ministry of Education, The Hague, The Netherlands.
dr. Lore Hoffmann, Institut für Pädagogik der Naturwissenschaften,(IPN) Kiel, BRD
drs. Jan G. Hondebrink, Foundation for Curriculum Devolpment (SLO), The Netherland
drs. Jan Hoogeveen, Foundation for Curriculum Devolpment (SLO) The Netherlands
ir. George Itz, Eindhoven University of Technology , The Netherlands.
Svein Lie, University of Oslo, Norway.
Lena-Pia Lindholm, University of Lund , Sweden.
Don Low Ed. D., Orange Coast College, Costa Mesa, Cal, USA.
drs. Ilja Mottier, Ministry of Education, The Hague, The Netherlands.
dr. Carol A. Niznik, University of Pittsburg, USA. (excused)
drs. Ineke de Raaff, Eindhoven University of Technology, The Netherlands.
prof.dr. Jan H.Raat, Eindhoven University of Technology, The Netherlands.
Isabel Romão, Commissao da Condicao Feminina, Lisboa, Portugal.
Marja Rooijakkers, Eindhoven University of Technology, The Netherlands.
dr. Doris Simonis, University of Montana, USA.
Barbara Simpson Ph.D., Gustavus Adolphus College, Minnesota, USA.
Svein Sjøberg, University of Oslo, Norway.
Barbara Smail, Manchester Polytechnic, UK.
drs. Gerrit Verkerk, Eindhoven University of Technology, The Netherlands.

Appendix B

LIST OF PAPERS

1. Mary R.Anderson (USA). *Women in science and engineering: A case of awareness and encouragement.*
2. Ruth Ann Cade & Robert Burr Cade(USA). *A multi-phased program for recruiting southern women into science based on extensive media use and interaction with suitable role models.*
3. Deanna Chitayat (USA). *Project Selamie.*
4. G.E. Chivers (UK). *Loughborough university women in engineering project.*
5. Janet Ferguson (CAN). *The science education of girls in Canada: a strategy for change.*
6. Lucile Fink (USA). *To attract and hold young women's interest in the physical sciences (so that they can achieve success equal to that of young men).*

6a. (Introduced by Lucile Fink, USA). *Fair textbooks, a resource guide.*

7. Jan Harding (UK). *Report on science examinations and the type of school.*
8. Lore Hoffmann (BRD). *Consequences for science education based on results of girls' learning interest.*
9. Don Low (USA). *A description of the science career workshop project for women in science.*
10. Ilja Mottier (The Neth.). *Girls and physics textbooks in the HANDROVER-project.*
11. Carol A. Niznik (USA). *Career and goal planning for girls entering the sciences and technology.*
12. Ineke de Raaff (The Neth.). *Special activities for women entering engineering at Eindhoven University.*
13. Jan H. Raat (The Neth.). *Intervention strategies in favour of girls' achievement in science (physics) and technology in the MENT-project.*
14. Isabel Romão (PORT). *Survey on women's position in the field of education.*

14a. Isabel Romão (PORT). *The "CHANGING ATTITUDES" Project.*

15 Doris Simonis (USA). *Women in science: a developing country.*

15a. Doris Simonis (USA). *Using analogies in energy education.*

16. Barbara Simpson (USA). *Recruitment of women scientists; status and proposal.*
17. Svein Sjøberg & Svein Lie (Norway). *Girls and physics.*

18. Barbara Smail, Judith Whyte & Alison Kelly (UK). *Girls into science and technology: the first two years.*
19. Gerrit Verkerk (The Neth.). *Differences in practical skills between boys and girls.*
20. Mathieu Dumont (The Neth.). *Case - study of the Pendulum - experiment.*
21. Lena-Pia Lindholm (Sweden). *Informing children about science and technology: Some suggestions and practical attempts.*
22. ir. B. ten Zeldam (The Neth.). *Opening address GASAT - conference.*

The full text of these papers is published in "CONTRIBUTIONS GASAT - conference 1981", except for the nrs. 6a, 14, 15a, 22, which were brought in later during the conference.

Some questions for discussion

1. Several papers suggest that the small number of girls in science and technology is not recognized as a problem. How best may we arouse concern about this issue among administrators - head teachers (principals) - teachers - parents?

2. Girls are said to be the most reluctant to change. Have we the right to try to change their attitudes? If so, what methods may we use?

3. Boys seem to hold more strongly stereotyped attitudes than do girls, who are then influenced by them. How may we/should we work with boys?

4. Many teachers of physics and technology are men. Some are suspicious of or feel threatened by what they see as the'women's right" movement. How may we change their attitudes?

5. Science/craft/technology teachers seem less ready to use behaviour-changing techniques. How should we approach these teachers?

6. Teachers who wish to respond to concern for girls into science and technology will need material resources. What resources would be most useful?

7. Several papers emphasize the importance for girls of personal contact with industry and with women models. But this may not be possible to arrange on the scale suggested in some papers. How may we make the most effective and efficient links between girls and women scientists/ technologists / craftworkers (especially the latter) and between girls and industry (personal, video, slide?) ?

8. Mathematics is recognized as an important skill. UK experience does not support the US/Fennema contention that if girls are taught math. they can do it. What may we do about girls'performance in mathematics?

9. Interests are at present more strongly stereotyped than are abilities. How may we use only interests without reinforcing stereotypes?

10. Girls-only activities have been recommended. What are the advantages/drawbacks of sex-segregated activities? Which would we recommend?

11. Girls arrive at school with disadvantages in science and technology compared to boys. What "remedial" experience do girls need? When is the most effective time to give these?

12. Several projects speak of changing school physics. What sorts of changes are implied? What barriers or constraints may hinder such a change? What about teachers' fear of a fall in "standards"?

13. We use the word "technology" on our title. What do we mean by "technology" in the school context? What experience should we offer? At what age? For which "ability"?

14. Young people often see technology as a threat. What do we do about "the unacceptable face" of technology?

15. Concern has been expressed about bias in text-books. Is it possible to recommend general guidelines to publishers which will be effective? Should we have specific guidelines for physics?

16. Formal assessment plays an important role in the image of self-as-competent and in the award of a qualification. How should we respond to recent findings of sex-bias in modes of assessment?

17. How best may we "preserve" the women and girls who have chosen to study science and/or technology?

GASAT *RESOURCES INFORMATION* CENTRE
Department of Physics & Technology
Eindhoven University of Technology
Postbox 513
5600 MB Eindhoven, The Netherlands

BEST COPY AVAILABLE

Girls And Science And Technology

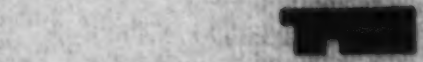
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]



Eindhoven University of Technology

BEST COPY AVAILABLE